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# The Effect of Ignition Timing Modifications on Emissions and Fuel Economy

(U.S.) Environmental Protection Agency
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# The Effect of Ignition Timing Modifications on Emissions and Fuel Economy

October 1975

Technology Assessment and Evaluation Branch
Emission Control Technology Division
Office of Mobile Source Air Pollution Control
Environmental Protection Agency

## Background

The Emission Control Technology Division of the Environmental Protection Agency is interested in engine control techniques that influence emissions and fuel economy. One engine parameter that is readily adjustable is basic ignition timing and it was desired that data be collected on a variety of late model (1975) vehicles to quantify its effect. Data from such a program would be useful in studies of inventor devices which occasionally include timing adjustments as part of the installation instructions, in tampering studies where investigations are made of the effect of emission control system modification, and in octane requirement problem investigations because of the influence of ignition timing on octane requirement.

## Test Vehicle Description

Ten vehicles were used in the test program. The vehicles were either production or prototype 1975 vehicles. The average mileage accumulated on the vehicles was 5800 miles. The maximum mileage was 10,000 and the minimum was 700. Most of the vehicles were within 1500 miles of the mean mileage.

Descriptions of each vehicle are given in the appendix.

## Test Program

Prior to being used in the test program, each test vehicle was checked for compliance with the manufacturer's tune-up specifications. Vehicles that did not comply were adjusted accordingly.

Exhaust emissions and fuel economy were measured using the 1975 Federal Test Procedure (Federal Register, Nov. 15, 1972, vol. 37 no. 221, Part II) and the EPA Highway Cycle. Unleaded fuel with a RON of 96 was used for all emission and fuel economy tests.

Each vehicle was tested at four ignition timing settings:

1) Baseline, manufacturer's setting.
2) $5^{o}$ retard from manufacturer's setting.
3) $2^{o}$ retard from manufacturer's setting.
4) $5^{o}$ advance from manufacturer's setting.

Three replicate tests were performed at each ignition timing setting. The range of ignition timings tested was confined to $\pm 5^{\circ}$ of manufacturer's specifications in order to avoid unrealistic excursions into excessive durability or octane requirement problems.

**TECHNICAL REPORT DATA**
*(Please read Instructions on the reverse before completing)*

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16. ABSTRACT

The Emission Control Technology Division of the Environmental Protection Agency is interested in engine control techniques that influence emissions and fuel economy. One engine parameter that is readily adjustable is basic ignition timing, and it was desired that data be collected on a variety of late model (1975) vehicles to quantify its effect. Data from such a program would be useful in studies of inventor devices which occasionally include timing adjustments as part of the installation instructions, in tampering studies where investigations are made of the effect of emission control system modification, and in octane requirement problem investigations because of the influence of ignition timing on octane requirement.

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After completing exhaust emissions and fuel economy tests, each vehicle was given a cursory road test to evaluate its tendency to knock on 91 RON fuel with ignition timing set at the manufacturer's specification. This evaluation consisted of fueling the vehicle with a 91 RON gasoline and driving on the road under conditions where spark knock might be expected to occur (such as low speed high load or full throttle operation). The fuel used for this portion of the test program was a commercially available unleaded fuel with a research octane of 90.9 and a motor octane of 83.3.

## Test Results

Fuel economy and exhaust emissions data for each vehicle are given in Tables I-X. The average change in fuel economy for all of the test vehicles in given in Table XI.

The data indicate that on the average, over the 1975 Federal Test Procedure (75 FTP) the fuel economy penalty for retarding ignition timing up to 5 degrees is 1 percent per degree retard.

Generally, the fuel economy of large vehicles powered by V-8 engines was affected less by retarded timing than was the fuel economy of the four and six cylinder smaller vehicles (Tables XII and XIII). The four cylinder Vega suffered the largest fuel economy penalty (10%) over the 75 FTP with a 5 degree retard. The Cadillac and Oldsmobile incurred only a 1% loss in fuel economy with a $5^{o}$ retard.

In most cases, the highway fuel economy was affected less by timing changes than the 75 FTP (urban) fuel economy. If the harmonic mean of the urban and highway fuel economies is calculated using weighting factors of 55% for the urban cycle and 45% for the highway cycle, then the results shown below are obtained.

| | $5^{o}$ Retard | $2^{o}$ Retard | $5^{o}$ Advance |
|---|---|---|---|
| Percent Change in Fuel Economy for all Vehicles | -4% | -2% | +5% |

The 55/45 Urban/Highway weighting factors are based on information regarding driving patterns in a Department of Transportation news release dated January 15, 1974. The above changes in fuel economy are probably more typical than either the urban or highway fuel economies considered separately.

During the knock testing portion of the program, only two vehicles (the Oldsmobile and Buick) exhibited audible knock. However, the test program covered a period of several months, and it was not possible to knock test each vehicle under the same temperature and humidity conditions. Most of the vehicle were tested between 40-60°F, and a few vehicles were tested at temperatures over 60°F. Because ambient conditions influence spark knock, it is possible that vehicles which did not knock at low temperatures may develop knock at higher temperatures.

The Oldsmobile experienced light knock when accelerating at full throttle at speeds above 25 mph. The knock was not considered to be noticeable enough to cause customer complaint.

The Buick experienced very audible knock when accelerating at 3/4 throttle at speeds above 30 mph. The knock was considered bad enough to cause customer complaint. The Buick suffered a 4% loss in fuel economy with a 5° retard using the weighted urban/highway method of comparing fuel economy.

When the ignition timing was retarded 5 degrees from baseline, none of the test vehicles exceeded the exhaust emission standards for the 1975 model year (HC - 1.5 gms/mi., CO - 15.0 gms/mi., NOx - 3.1 gms/mi.). In most cases, retarding the ignition timing increased emissions of CO and decreased emissions of NOx. The increases in CO ranged from 5% to 68%, with an average increase of 28%. Only one vehicle had a decrease in CO with retarded timing. The decreases in NOx ranged from 3% to 24%, with an average decrease of 15%. Half the test vehicles had higher HC emissions when the timing was retarded, and half had lower HC emissions.

Advancing the ignition timing 5 degrees from the baseline setting caused only one vehicle to exceed the NOx standard of 3.1 gpm. NOx emissions from all vehicles increased an average of 19%. Advancing the timing caused HC and CO emissions to increase for some vehicle and decrease for others, and no general trend was evident.

## Conclusions

The data indicate that on the average, the fuel economy penalty for retarding ignition timing to alleviate spark knock is about one percent per degree of retard up to a maximum of five degrees retard. The actual penalty when the urban and highway fuel economies are averaged together is four percent with five degrees of retard.

Retarding the ignition timing can be expected to increase CO emissions and decrease NOx emissions.

Table I

Fuel Economy vs. Ignition Timing
1975 Buick 455 CID
1975 FTP

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 10.4 | 10.8 | 12.0 | 11.0 | 15.5 | 0.44 | 2.84 | 802. | 2.33 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 9.8 | 10.2 | 11.4 | 10.4 | 15.5 | 0.36 | 3.72 | 846. | 1.77 |
| % Change from baseline | -6% | -6% | -5% | -5% | 0 | -18% | +31% | +5% | -24% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 10.0 | 10.4 | 11.6 | 10.6 | 15.4 | 0.41 | 4.31 | 827. | 2.05 |
| % Change from baseline | -4% | -4% | -3% | -4% | -1% | -7% | +52% | +3% | -12% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 10.6 | 10.8 | 12.3 | 11.1 | 16.0 | 0.48 | 4.08 | 789. | 2.49 |
| % Change from baseline | +2% | 0 | +3% | +1% | +3% | +9% | +44% | -2% | +7% |

Table II

Fuel Economy vs. Ignition Timing
1975 Cadillac 500 CID
1975 FTP

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 10.4 | 11.7 | 12.5 | 11.7 | 16.0 | 0.49 | 2.18 | 755. | 2.19 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 10.3 | 11.6 | 12.5 | 11.6 | 16.0 | 0.41 | 2.67 | 763. | 1.82 |
| % Change from baseline | -1% | -1% | 0 | -1% | 0 | -16% | +22% | +1% | -17% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 10.5 | 11.7 | 12.5 | 11.6 | 16.2 | 0.58 | 3.36 | 756. | 2.06 |
| % Change from baseline | +1% | 0 | 0 | -1% | +1% | +18% | +54% | 0 | -6% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 11.1 | 12.0 | 13.1 | 12.1 | 16.9 | 0.55 | 2.81 | 728. | 2.78 |
| % Change from baseline | +7% | +3% | +5% | +3% | +6% | +12% | +29% | -4% | +27% |

Table III

Fuel Economy vs. Ignition Timing
1975 Chevrolet 350 CID
1975 FTP

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 12.3 | 12.1 | 14.1 | 12.7 | 17.7 | 0.77 | 5.40 | 690. | 1.90 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 11.8 | 11.3 | 13.3 | 11.9 | 17.7 | 0.63 | 4.85 | 737. | 1.75 |
| % Change from baseline | -5% | -7% | -6% | -6% | 0 | -18% | -10% | +7% | -8% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 12.2 | 11.8 | 13.8 | 12.4 | 18.1 | 0.67 | 5.22 | 708. | 1.85 |
| % Change from baseline | -1% | -2% | -2% | -2% | +2% | -13% | -3% | +3% | -3% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 12.6 | 12.7 | 14.7 | 13.1 | 18.6 | 0.64 | 5.28 | 664. | 2.62 |
| % Change from baseline | +2% | +5% | +4% | +3% | +5% | -17% | -2% | -4% | +38% |

Table IV

Fuel Economy vs. Ignition Timing
1975 Oldsmobile 455 CID
1975 FTP

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 11.2 | 12.4 | 13.3 | 12.3 | 16.4 | 0.52 | 1.57 | 715. | 2.56 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 10.9 | 12.3 | 13.1 | 12.2 | 16.3 | 0.39 | 1.76 | 725. | 1.99 |
| % Change from baseline | -3% | -1% | -2% | -1% | -1% | -25% | +12% | +1% | -22% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 11.0 | 12.2 | 13.0 | 12.1 | 16.3 | 0.45 | 1.64 | 729. | 2.39 |
| % Change from baseline | -2% | -2% | -2% | -2% | -1% | -13% | +4% | +2% | -7% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 11.6 | 12.5 | 13.6 | 12.6 | 16.8 | 0.49 | 1.25 | 702. | 3.07 |
| % Change from baseline | +4% | +1% | +2% | +2% | +2% | -6% | -20% | -2% | +20% |

Table V

Fuel Economy vs. Ignition Timing
1975 Ventura 250 CID
1975 FTP

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 13.9 | 15.4 | 16.7 | 15.4 | 20.1 | 0.43 | 5.99 | 568. | 2.30 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 12.6 | 14.6 | 15.0 | 14.3 | 17.8 | 0.90 | 7.17 | 607. | 1.96 |
| % Change from baseline | -9% | -5% | -10% | -7% | -11% | +109% | +20% | +7% | -15% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 13.1 | 14.9 | 15.6 | 14.7 | 18.7 | 0.74 | 7.03 | 592. | 2.11 |
| % Change from baseline | -6% | -3% | -7% | -5% | -7% | +72% | +17% | +4% | -8% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 14.3 | 16.4 | 17.3 | 16.1 | 21.3 | 0.42 | 5.45 | 540. | 2.89 |
| % Change from baseline | +3% | +6% | +4% | +5% | +6% | -2% | -9% | -5% | +26% |

Table VI

Fuel Economy vs. Ignition Timing
1975 Vega 140 CID
1975 FTP

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 17.9 | 20.3 | 21.6 | 20.0 | 27.8 | 0.32 | 6.37 | 431. | 1.05 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 16.3 | 18.2 | 19.7 | 18.1 | 24.6 | 0.38 | 9.34 | 474. | 1.02 |
| % Change from baseline | -9% | -10% | -9% | -10% | -12% | +19% | +47% | +10% | -3% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 17.2 | 19.2 | 20.8 | 19.1 | 26.8 | 0.30 | 6.71 | 454. | 1.03 |
| % Change from baseline | -4% | -5% | -4% | -5% | -4% | -6% | +5% | +5% | -2% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 18.4 | 21.1 | 22.7 | 20.9 | 29.7 | 0.33 | 5.20 | 415. | 1.20 |
| % Change from baseline | +3% | +4% | +5% | +5% | +7% | +3% | -18% | -4% | +14% |

Table VII

Fuel Economy vs. Ignition Timing
1975 AMC Matador 304 CID
1975 FTP

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 12.9 | 13.4 | 14.6 | 13.6 | 18.0 | 0.42 | 2.81 | 647. | 2.59 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 12.1 | 12.3 | 13.9 | 12.6 | 17.4 | 0.51 | 4.71 | 693. | 1.98 |
| % Change from baseline | -6% | -8% | -5% | -7% | -3% | +21% | +68% | +7% | -24% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 12.5 | 12.9 | 14.2 | 13.1 | 17.6 | 0.49 | 3.40 | 669. | 2.34 |
| % Change from baseline | -3% | -4% | -3% | -4% | -2% | +17% | +21% | +3% | -10% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 13.1 | 13.8 | 15.2 | 14.0 | 18.5 | 0.46 | 3.27 | 627. | 2.74 |
| % Change from baseline | +2% | +3% | +4% | +3% | +3% | +10% | +16% | -3% | +6% |

Table VIII

Fuel Economy vs. Ignition Timing
1975 Dodge Dart 225 CID
1975 FTP

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 15.7 | 17.0 | 17.9 | 16.9 | 23.8 | 0.48 | 6.99 | 512. | 2.53 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 15.3 | 15.6 | 17.4 | 16.0 | 23.1 | 0.52 | 7.95 | 541. | 2.15 |
| % Change from baseline | -3% | -8% | -3% | -5% | -3% | +8% | +14% | +6% | -15% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 15.7 | 16.0 | 17.8 | 16.4 | 22.6 | 0.49 | 6.58 | 530. | 2.27 |
| % Change from baseline | 0 | -6% | -1% | -3% | -5% | +2% | -6% | +4% | -10% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 16.6 | 18.4 | 19.7 | 18.4 | 25.1 | 0.61 | 6.63 | 471. | 3.13 |
| % Change from baseline | +6% | +8% | +10% | +9% | +5% | +27% | -5% | -8% | +24% |

Table IX

Fuel Economy vs. Ignition Timing
1975 Plymouth Fury 318 CID
1975 FTP

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 11.0 | 12.1 | 13.4 | 12.2 | 18.0 | 0.45 | 6.82 | 717. | 2.82 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 10.5 | 12.2 | 12.7 | 11.9 | 17.8 | 0.42 | 8.97 | 730. | 2.31 |
| % Change from baseline | -5% | +1% | -5% | -2% | -1% | -7% | +32% | +2% | -18% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 11.1 | 12.2 | 13.2 | 12.2 | 18.2 | 0.46 | 8.63 | 712. | 2.48 |
| % Change from baseline | +1% | +1% | -2% | 0 | +1% | +2% | +27% | -1% | -12% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 12.6 | 13.6 | 15.0 | 13.8 | 18.6 | 0.52 | 8.21 | 630. | 3.52 |
| % Change from baseline | +15% | +12% | +12% | +13% | +3% | +16% | +20% | -12% | +25% |

**Table X**
**Fuel Economy vs. Ignition Timing**
**1975 Ford 460 CID**
**1975 FTP**

| | Fuel Economy Miles Per Gallon | | | | | Mass Emissions Grams Per Mile | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG | HC | CO | $CO_2$ | NOx |
| Baseline | 10.0 | 9.3 | 10.9 | 9.8 | 16.1 | 0.59 | 5.79 | 890. | 2.07 |
| $5^{o}$ Retard | | | | | | | | | |
| Average | 9.6 | 8.9 | 10.5 | 9.5 | 14.9 | 0.61 | 6.07 | 929. | 1.95 |
| % Change from baseline | -4% | -4% | -4% | -3% | -7% | +3% | +5% | +4% | -6% |
| $2^{o}$ Retard | | | | | | | | | |
| Average | 9.9 | 9.2 | 11.0 | 9.8 | 16.0 | 0.55 | 5.93 | 895. | 1.98 |
| % Change from baseline | -1% | -1% | +1% | 0 | -1% | -7% | +2% | +1% | -4% |
| $5^{o}$ Advance | | | | | | | | | |
| Average | 10.9 | 10.4 | 12.2 | 11.0 | 16.4 | 1.14 | 10.7 | 790. | 2.20 |
| % Change from baseline | +9% | +12% | +12% | +12% | +2% | +93% | +85% | -11% | +6% |

Table XI

Percent Change in Fuel Economy
Average of Vehicles

| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG |
|---|---|---|---|---|---|
| 5° Retard | -5% | -5% | -5% | -5% | -4% |
| 2° Retard | -2% | -3% | -2% | -3% | -2% |
| 5° Advance | +5% | +5% | +6% | +6% | +4% |

Table XII

Percent Change in Fuel Economy
V-8 Engines

| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG |
|---|---|---|---|---|---|
| 5° Retard | -4% | -4% | -4% | -4% | -2% |
| 2° Retard | -1% | -2% | -2% | -2% | -1% |
| 5° Advance | +6% | +5% | +6% | +5% | +3% |

Table XIII

Percent Change in Fuel Economy
Four and Six Cylinder Engines

| | Bag 1 | Bag 2 | Bag 3 | 75 FTP MPG | Highway MPG |
|---|---|---|---|---|---|
| 5° Retard | -7% | -8% | -7% | -7% | -9% |
| 2° Retard | -3% | -5% | -4% | -4% | -5% |
| 5° Advance | +4% | +6% | +6% | +6% | +6% |

# Appendix

# TEST VEHICLE DESCRIPTION

Chassis model year/make - 1975 AMC Matador
Emission control system - OC/EGR/AIR

## Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, V-8, ohv |
| bore x stroke | 3.75 x 3.44 in./95.3 x 87.4 mm |
| displacement | 304 cu in./4983 cc |
| compression ratio | 8.4:1 |
| maximum power @ rpm | 150 net hp @ 4200 rpm/112 kW @ 4200 rpm |
| fuel metering | 2 barrel carburetor |
| fuel requirement | 91 RON, unleaded |

## Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | 3.15:1 |

## Chassis

| | |
|---|---|
| type | Unibody, front engine, rear wheel drive |
| tire size | F 78 x 14 |
| curb weight | 3870 lbs./1755 kg |
| inertia weight | 4000 lbs. |
| passenger capacity | 6 |

## Emission Control System

| | |
|---|---|
| basic type | OC/EGR/AIR |
| oxidation catalyst location | Underfloor |
| substrate | Pellet |
| volume | 160 cu in./2622 cc |
| loading | .05 troy oz./1.56 grams |
| EGR type | |
| rate | N/A |
| air injection | |
| size pump | 19 cu in. per rev/311 cc per rev |
| drive ratio | 1.25:1 |
| location | exhaust manifold near ports |
| durability accumulated on system | 5800 miles/9300 km |

## TEST VEHICLE DESCRIPTION

Chassis model year/make - 1975 Dodge Dart Custom
Emission control system - OC/EGR/EM

### Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, 1-6, ohv |
| bore x stroke | 3.40 x 4.125 in./86.4 x 104.8 mm |
| displacement | 225 cu in./3688 cc |
| compression ratio | 8.4:1 |
| maximum power @ rpm | 100 net hp @ 3600 rpm/75 kW @ 3600 rpm |
| fuel metering | 1 barrel carburetor |
| fuel requirement | 91 RON, unleaded |

### Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | 3.15:1 |

### Chassis

| | |
|---|---|
| type | Unibody, front engine, rear wheel drive |
| tire size | E 78 x 14 |
| curb weight | 3480 lbs/1579 kg |
| inertia weight | 4000 lbs. |
| passenger capacity | 6 |

### Emission Control System

| | |
|---|---|
| basic type | OC/EGR/EM |
| oxidation catalyst location | Underfloor |
| substrate | Monolith extrusion |
| volume | Small oval |
| loading | .04 troy oz./1.24 gm per monolith 70/30 Pt/Pd |
| EGR type | Venturi vacuum amplified |
| rate | N.A. |
| durability accumulated on system | 4500 miles/7200 km |

# TEST VEHICLE DESCRIPTION

Chassis model year/make - 1975 Plymouth Fury
Emission control system - OC/EGR/EM

## Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, V-8, ohv |
| bore x stroke | 3.91 x 3.31 in./99.3 x 84.1 mm |
| displacement | 318 cu in./5212 cc |
| compression ratio | 8.5:1 |
| maximum power @ rpm | 145 net hp @ 4000 rpm/108 kW @ 4000 rpm |
| fuel metering | 2 barrel carburetor |
| fuel requirement | 91 RON, unleaded |

## Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | 2.71:1 |

## Chassis

| | |
|---|---|
| type | Unibody, front engine, rear wheel drive |
| tire size | GR 78 x 15 |
| curb weight | 4210 lbs./1910 kg |
| inertia weight | 4500 lbs. |
| passenger capacity | 6 |

## Emission Control System

| | |
|---|---|
| basic type | OC/EGR/EM |
| oxidation catalyst location | Underfloor |
| substrate | Monolith extrusion |
| volume | large oval |
| loading | .05 troy oz./1.56 gm per monolith (2) |
| EGR type | Venturi, vacuum amplified |
| rate | N.A. |
| durability accumulated on system | 700 miles/1100 km |

# TEST VEHICLE DESCRIPTION

Chassis model year/make - 1973 Chevrolet Belair (prototype 1975)
Emission control system - OC/EGR

## Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, V-8 ohv |
| bore x stroke | 4.00 x 3.48 in./101.6 x 88.4 mm |
| displacement | 350 cu in./5737 cc |
| compression ratio | 8.2:1 |
| maximum power @ rpm | N.A. |
| fuel metering | GM integrated fuel system |
| fuel requirement | 91 RON, unleaded |

## Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | N.A. |

## Chassis

| | |
|---|---|
| type | Body/frame, front engine, rear wheel drive |
| tire size | H 78 x 15 |
| curb weight | 4397 lbs./1994 kg |
| inertia weight | 4500 lbs. |
| passenger capacity | 6 |

## Emission Control System

| | |
|---|---|
| basic type | OC/EGR |
| oxidation catalyst location | Underfloor |
| substrate | Pellet, alumina |
| volume | 260 cu in./4261 cc |
| loading | .05 troy oz./1.56 gm |
| EGR type | Ported |
| rate | N.A. |
| durability accumulated on system | 9600 miles/15500 km |

# TEST VEHICLE DESCRIPTION

Chassis model year/make - 1975 Pontiac Ventura
Emission control system - OC/EGR/EFE

## Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, 1-6, ohv |
| bore x stroke | 3.88 x 3.53 in/98.6 x 89.7 mm |
| displacement | 250 cu in./4098 cc |
| compression ratio | 8.22:1 |
| maximum power @ rpm | 105 net hp @ 3800 rpm/78 kW @ 3800 rpm |
| fuel metering | 1 barrel carburetor |
| fuel requirement | 91 RON, unleaded |

## Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | 2.73:1 |

## Chassis

| | |
|---|---|
| type | Body/frame, front engine, rear wheel drive |
| tire size | FR 78 x 14 |
| curb weight | 3585 lbs./1626 kg |
| inertia weight | 4000 lbs. |
| passenger capacity | 6 |

## Emission Control System

| | |
|---|---|
| basic type | OC/EGR/EFE |
| oxidation catalyst location | Underfloor |
| substrate | Pellet, alumina |
| volume | 260 cu in./4261 cc |
| loading | .05 troy oz./1.56 gm |
| EGR type | Ported |
| rate | N.A. |
| durability accumulated on system | 4900 miles/7900 km |

## TEST VEHICLE DESCRIPTION

**Chassis model year/make -** 1975 Vega
**Emission control system -** OC/EGR

### Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, 1-4, ohv |
| bore x stroke | 3.50 x 3.63 in./88.9 x 92.2 mm |
| displacement | 140 cu in./2295 cc |
| compression ratio | 7.9:1 |
| maximum power @ rpm | 87 net hp @ 4400 rpm/65 kW @ 4400 rpm |
| fuel metering | 2 barrel carburetor |
| fuel requirement | 91 RON, unleaded |

### Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | 2.92:1 |

### Chassis

| | |
|---|---|
| type | Body/frame, front engine, rear wheel drive |
| tire size | BR 78 x 13 |
| curb weight | 2580 lbs./1170 kg |
| inertia weight | 2750 lbs. |
| passenger capacity | 4 |

### Emission Control System

| | |
|---|---|
| basic type | OC/EGR |
| oxidation catalyst location | Underfloor |
| substrate | Pellet, alumina |
| volume | 160 cu in./2622 cc |
| loading | .05 troy oz./1.56 gm |
| EGR type | Ported |
| rate | N.A. |
| durability accumulated on system | 4000 miles/6400 km |

# TEST VEHICLE DESCRIPTION

Chassis model year/make - 1975 Cadillac Calais
Emission control system - OC/EGR/EFE

## Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, V-8, ohv |
| bore x stroke | 4.30 x 4.30 in./109.2 x 109.2 mm |
| displacement | 500 cu in./8195 cc |
| compression ratio | 8.5 :1 |
| maximum power @ rpm | 205 bhp @ 3600 rpm/153 kW @ 3600 rpm |
| fuel metering | 4 barrel carburetor |
| fuel requirement | 91 RON, unleaded |

## Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | 2.73:1 |

## Chassis

| | |
|---|---|
| type | Body/frame, front engine, rear wheel drive |
| tire size | LR 78 x 15 |
| curb weight | N.A. |
| inertia weight | 5500 lbs. |
| passenger capacity | 6 |

## Emission Control System

| | |
|---|---|
| basic type | OC/EGR/EFE |
| oxidation catalyst location | Underfloor |
| substrate | Pellet, alumina |
| volume | 260 cu in./4261 cc |
| loading | .05 troy oz./1.56 gm |
| EGR type | Ported |
| rate | N.A. |
| durability accumulated on system | 5600 miles/9000 km |

# TEST VEHICLE DESCRIPTION

Chassis model year/make - 1975 Buick
Emission control system - OC/EGR/EFE

## Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, V-8, ohv |
| bore x stroke | 4.31 x 3.90 in./109.5 x 99.1 mm |
| displacement | 455 CID/7457 cc |
| compression ratio | 7.9:1 |
| maximum power @ rpm | 205 bhp @ 3800 rpm/153 kW @ 3800 rpm |
| fuel metering | 4 barrel carburetor |
| fuel requirement | 91 RON unleaded |

## Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | 2.73:1 |

## Chassis

| | |
|---|---|
| type | body/frame, front engine, rear wheel drive |
| tire size | J 78 x 15 |
| curb weight | 5050 lbs./2291 kg |
| inertia weight | 5500 lbs. |
| passenger capacity | 6 |

## Emission Control System

| | |
|---|---|
| basic type | OC/EGR/EFE |
| oxidation catalyst location | Underfloor |
| substrate | Pellet, alumina |
| volume | 260 CID/4261 cc |
| loading | .05 troy oz./1.56 gm |
| EGR type | Ported |
| rate | N.A. |
| durability accumulated on system | 6500 miles/10500 km |

# TEST VEHICLE DESCRIPTION

**Chassis model year/make - 1975 Oldsmobile**
**Emission control system - OC/EGR**

## Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, V-8, ohv |
| bore x stroke | 4.126 x 4.25 in./104.8 x 108 mm |
| displacement | 455 CID/7457 cc |
| compression ratio | 8.0:1 |
| maximum power @ rpm | N.A. |
| fuel metering | 4 barrel carburetor |
| fuel requirement | 91 RON, unleaded |

## Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | 2.56:1 |

## Chassis

| | |
|---|---|
| type | body/frame, front engine, rear wheel drive |
| tire size | JR 78 x 15 |
| curb weight | 5125 lbs./2325 kg |
| inertia weight | 5500 lbs. |
| passenger capacity | 6 |

## Emission Control System

| | |
|---|---|
| basic type | OC/EGR |
| oxidation catalyst location | Underfloor |
| substrate | Pellet, alumina |
| volume | 260 cu in./4261 cc |
| loading | .05 troy oz./1.56 gm |
| EGR type | Ported |
| rate | N.A. |
| durability accumulated on system | 10,000 miles/16,000 km |

## TEST VEHICLE DESCRIPTION

Chassis model year/make - 1975 Ford LTD
Emission control system - OC/EGR/AIR

### Engine

| | |
|---|---|
| type | 4 stroke, Otto cycle, V-8, ohv |
| bore x stroke | 4.36 x 3.85 in./110.7 x 97.8 mm |
| displacement | 460 cu in./7539 cc |
| compression ratio | 8.0:1 |
| maximum power @ rpm | 253 net hp @ 4400 rpm/189 kW @ 4400 rpm |
| fuel metering | 4 barrel carburetor |
| fuel requirement | 91 RON, unleaded |

### Drive Train

| | |
|---|---|
| transmission type | 3 speed automatic |
| final drive ratio | 2.75:1 |

### Chassis

| | |
|---|---|
| type | Body/frame, front engine, rear wheel drive |
| tire size | HR 78 x 15 |
| curb weight | 4825 lbs./2189 kg |
| inertia weight | 5000 lbs. |
| passenger capacity | 6 |

### Emission Control System

| | |
|---|---|
| basic type | OC/EGR/AIR |
| oxidation catalyst location | Toe board |
| substrate | monolithic, cordierite/mullite/alpha alumina |
| volume | 66 cu in./1082 cc |
| loading | N.A. |
| EGR type | vacuum actuated |
| rate | N.A. |
| air injection | |
| size pump | 14 cu in./229 cc |
| drive ratio | 1.25:1 |
| location | exhaust port |
| durability accumulated on system | 6500 miles/10500 km |